US005969943A

United States Patent [19]

Oyamada

[11] **Patent Number: 5,969,943**

[45] **Date of Patent: Oct. 19, 1999**

[54] **DEVICE HAVING AN EFFICIENT HEAT RADIATION CASING**

[75] Inventor: **Takashi Oyamada**, Tokyo, Japan

[73] Assignee: **NEC Corporation**, Tokyo, Japan

[21] Appl. No.: **09/169,947**

[22] Filed: **Oct. 13, 1998**

[30] **Foreign Application Priority Data**

Oct. 13, 1997 [JP] Japan 9-279166

[51] **Int. Cl.**[6] **H05K 7/20**

[52] **U.S. Cl.** **361/695**; 361/690; 361/697; 361/704; 257/722; 174/16.1; 174/16.3; 165/80.3

[58] **Field of Search** 361/690, 694, 361/695, 697, 704; 257/721, 722; 174/16.1, 16.3; 165/80.3

[56] **References Cited**

U.S. PATENT DOCUMENTS

5,523,918 6/1996 Chiou 361/695

5,597,034 1/1997 Barker, III et al. 165/80.3

FOREIGN PATENT DOCUMENTS

61-208296 9/1986 Japan .
4-32300 2/1992 Japan .
8-321571 12/1996 Japan .

Primary Examiner—Leo P. Picard
Assistant Examiner—Boris L. Chervinsky
Attorney, Agent, or Firm—Foley & Lardner

[57] **ABSTRACT**

A communication device for use in a base station of a portable telephone system has a radiation section including a spiral projection formed on an external surface of a casing to define a spiral air passage on the casing, a fan disposed on the casing inside a central space of the spiral passage, and a motor disposed inside the casing to drive the fan through a shaft penetrating the wall of the casing. A spiral air flow generated by the fan functions for efficient heat radiation through the casing. The spiral projection is formed by drawing the wall of the casing.

4 Claims, 4 Drawing Sheets

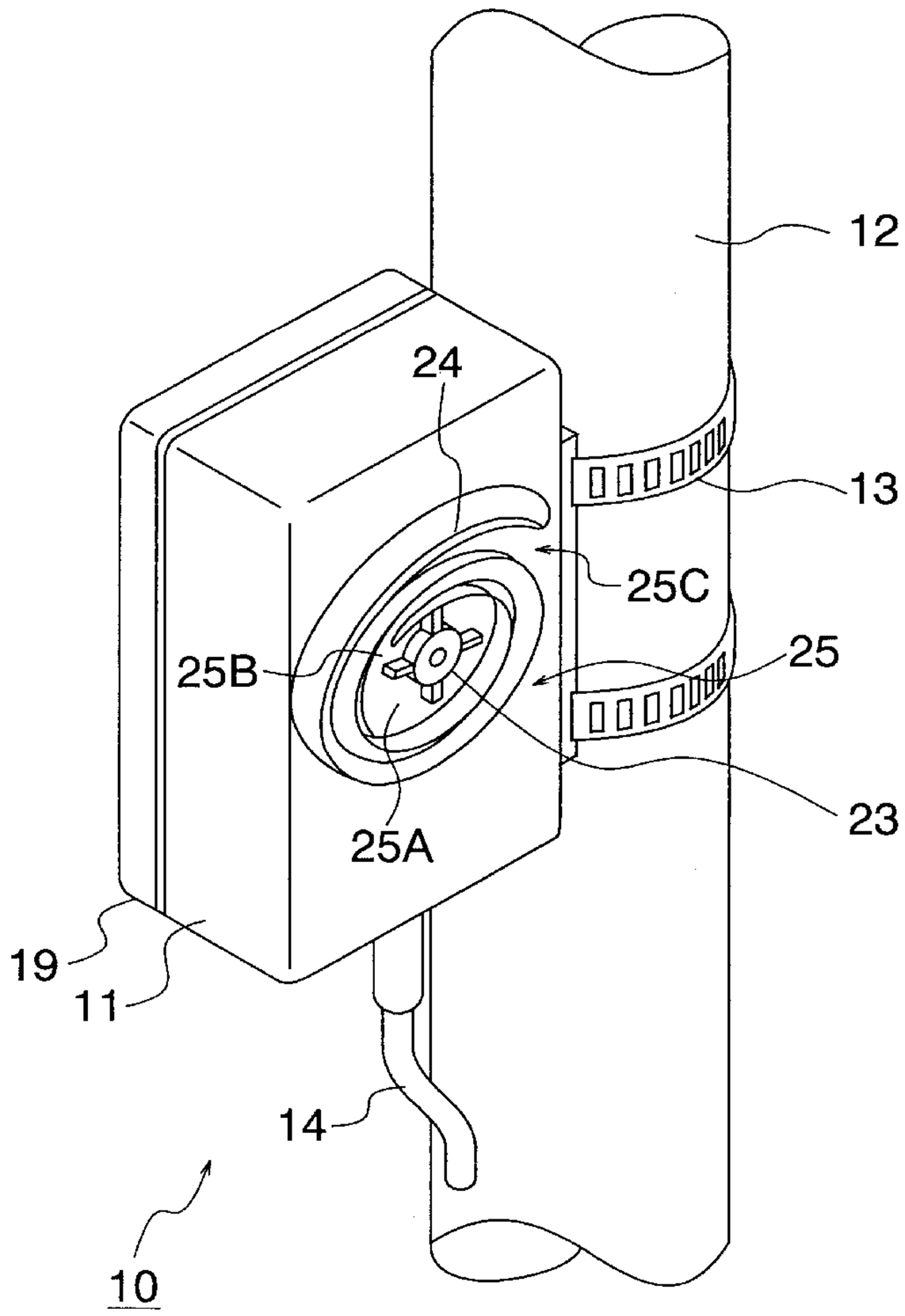


FIG. 1 PRIOR ART

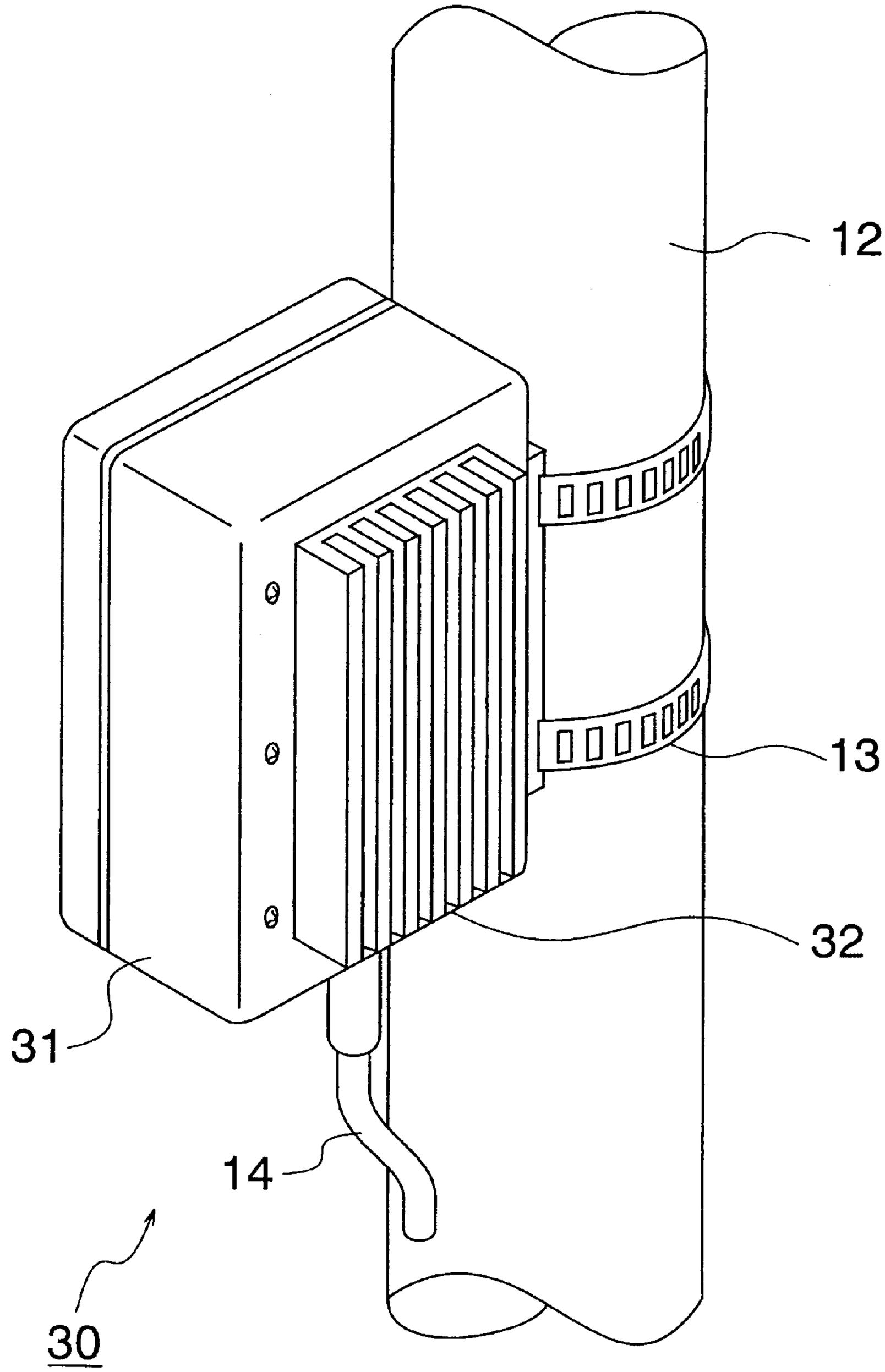


FIG. 2 PRIOR ART

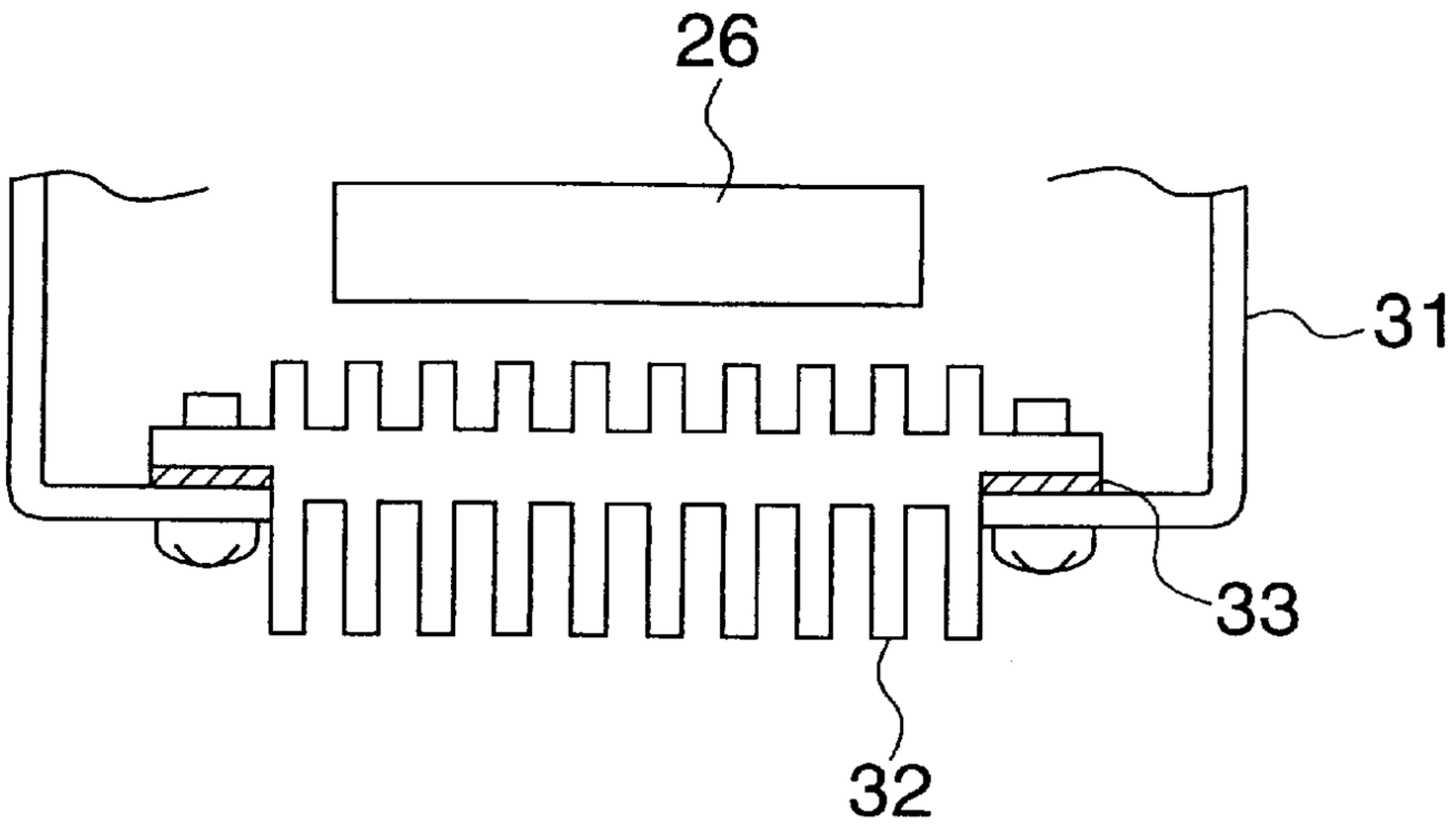


FIG. 3 PRIOR ART

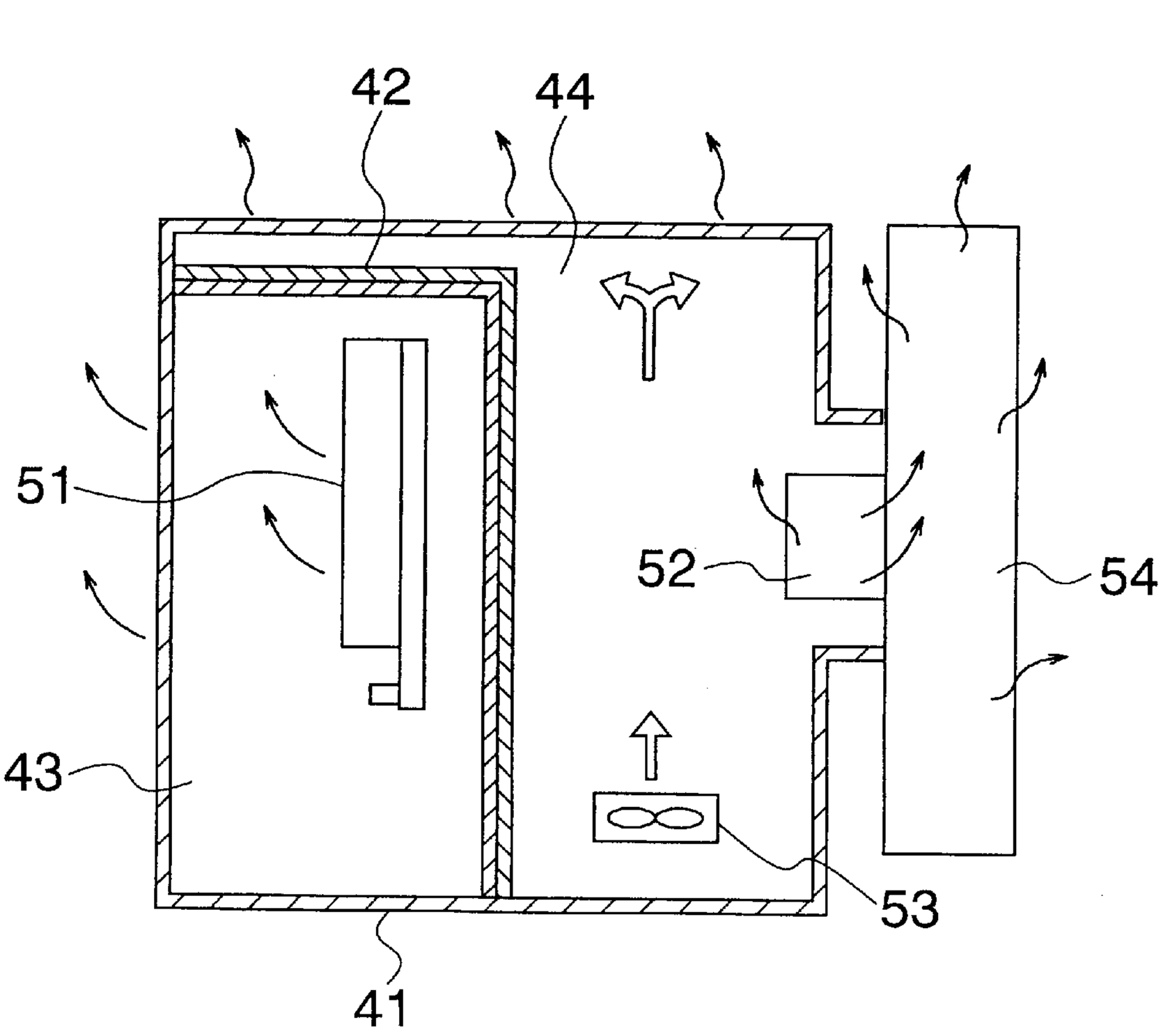


FIG. 4

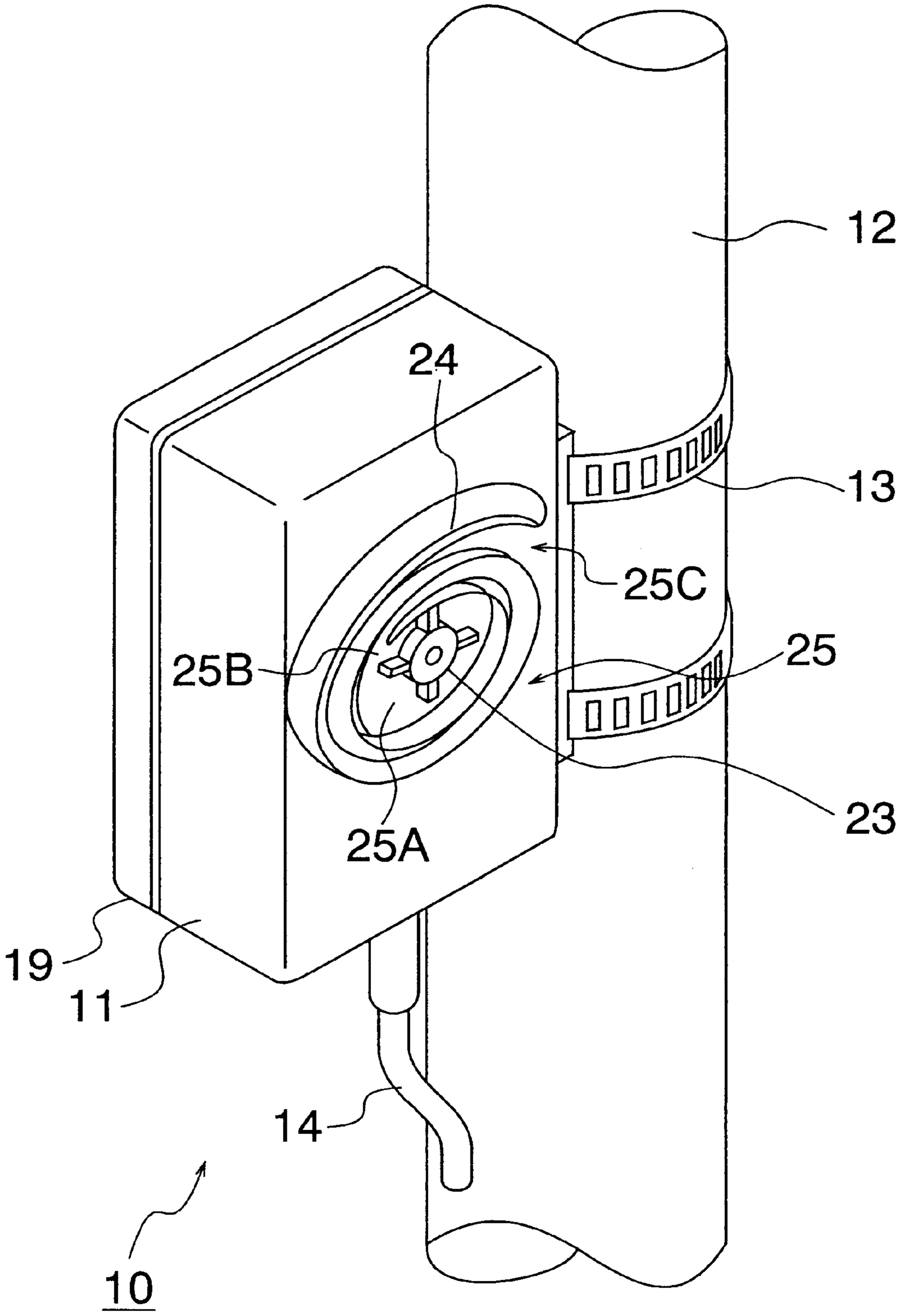
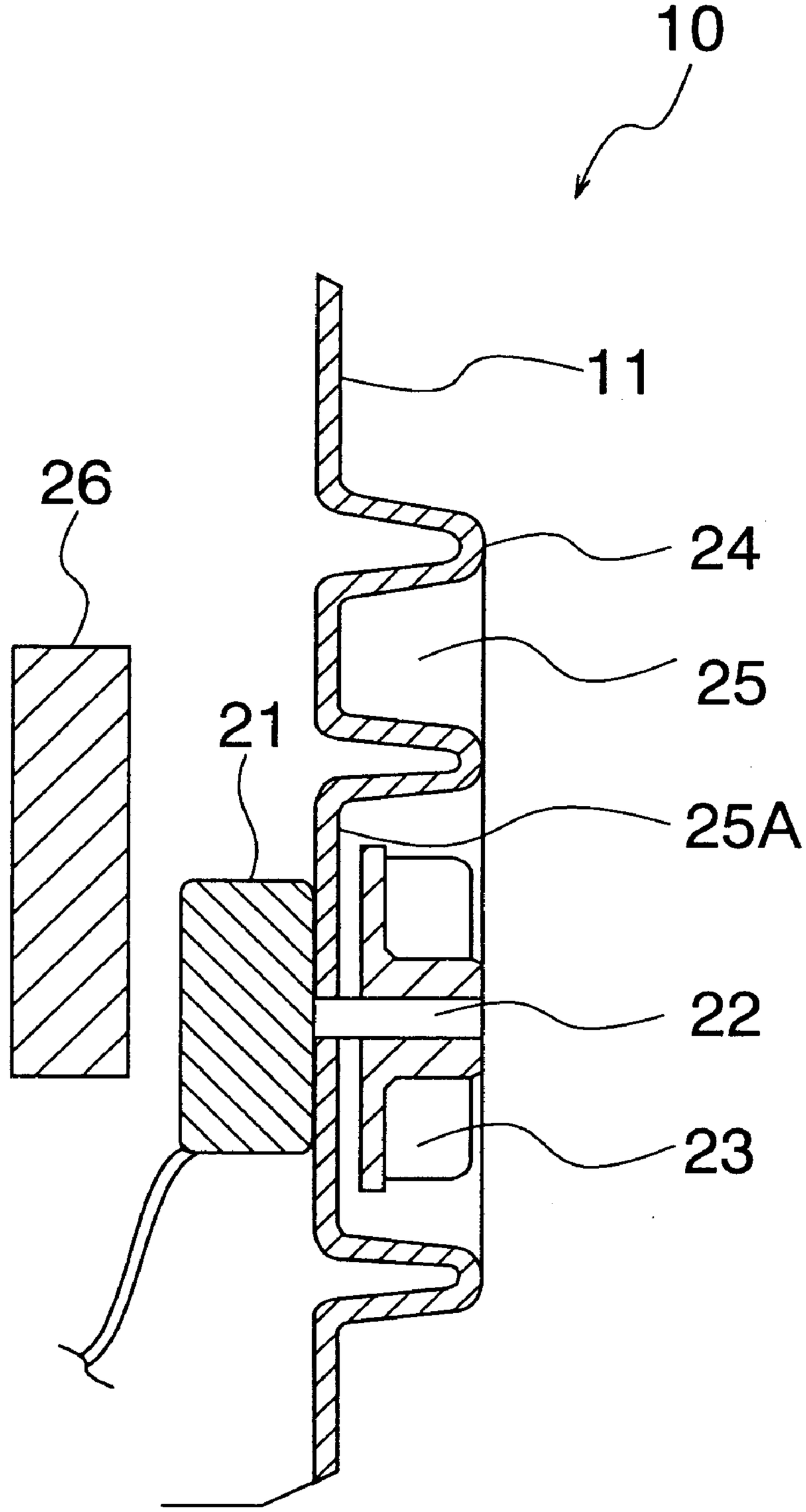


FIG. 5



DEVICE HAVING AN EFFICIENT HEAT RADIATION CASING

BACKGROUND OF THE INVENTION

(a) Field of the Invention

The present invention relates to a device having an efficient heat radiation casing and, more particularly, to a device having an efficient radiation casing of a closed structure, for use as a communication device in a base station of a portable telephone system.

(b) Description of the Related Art

Telecommunication devices for use in base stations of a portable telephone system have been remarkably reduced in their dimensions, resulting from the recent development of the semiconductor technology. Accordingly, the amount of heat generated per unit area inside the communication device is significantly increased, which requires an efficient heat radiation from the device. On the other hand, the number of closed type telecommunication devices including waterproofing has increased because these devices are installed outside more and more frequently with the reduction of the dimensions.

Referring to FIG. **1** showing a conventional communication device mounted on a pole **12** with a pair of straps **13**, the communication device **30** has a casing **31** with a radiator **32** mounted on the back surface thereof. Referring additionally to FIG. **2** showing a partial sectional view of the communication device of FIG. **1**, taken along a horizontal plane, the radiator **32** is attached to the casing **31** for radiating the heat generated in a heat source **26** toward outside the casing **31**. A gasket **33** is inserted between the casing **31** and the outer periphery of the radiator **32** for assuring a waterproof function.

The radiator **32** is generally made by machining a drawn aluminum bar, which raises the cost of the device. The natural radiation of the device through the radiator **32** and the casing **31** requires a large external surface area of the device, which raises the external dimensions and the weight of the device. In particular, the radiation efficiency depends on the wind velocity around the device, wherein a small wind velocity reduces the radiation efficiency.

The radiator **32** has a plurality of grooves for air flow, which limits the allowable posture of the casing **31** so that the grooves of the radiator **32** extend in the vertical direction.

Referring to FIG. **3** showing a sectional view of another conventional communication device, the communication device has a casing **41** separated by a heat insulator plate **42** into two chambers **43** and **44**. The chamber **44** receives therein a main power circuit **52** which radiates a large amount of heat, whereas the chamber **43** receives therein a control circuit **51** such as a printed circuit board, which radiates a smaller amount of heat and is less heat-resistant compared to the main power circuit **52**. A fan **53** is installed in the chamber **44**, with a radiator **54** such as a fin attached to a portion of the casing **41** for the chamber **44**. The communication device of FIG. **3** is described in JP-A-4-32300.

The proposed device, however, requires a large external surface area for heat radiation, and the fan **53** and the radiator **54** increase the dimensions of the communication device. In addition, the control circuit **51** is significantly affected by the heat generated in the main power circuit **52** notwithstanding the improved structure.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an apparatus having a new and improved heat radiation structure, for use as a closed type communication device in a base station of a portable telecommunication system, which has a simple structure and small dimensions and is not limited in its posture for mounting.

The present invention provides an apparatus comprising a casing having an external surface, a spiral projection formed on the external surface to form a spiral air passage on the external surface, the spiral air passage including a central space, an inner air inlet portion communicated with the central space and an outer air outlet portion, a fan disposed in the central space.

In accordance with the apparatus of the present invention, the heat generated inside the casing can be effectively radiated through the wall of the casing by the function of the spiral air passage and the associated fan.

The above and other objects, features and advantages of the present invention will be more apparent from the following description, referring to the accompanying as drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a conventional communication device;

FIG. **2** is a partial sectional view of the communication device of FIG. **1**:

FIG. **3** is a sectional view of another conventional communication device;

FIG. **4** is a perspective view of a communication device as an apparatus according to an embodiment of the present invention; and

FIG. **5** is a sectional view of the communication device of FIG. **4**.

PREFERRED EMBODIMENTS OF THE INVENTION

Now, the present invention is more specifically described with reference to accompanying drawings.

Referring to FIG. **4**, a communication device, generally designated by numeral **10** and shown as an example of the apparatus according to an embodiment of the present invention, includes a casing **11** suited for mounting the device on a pole **12** with a pair of straps **13**, and a front cover **19** attached to the casing **11** with a hinge. The casing **11** has a spiral air passage **25** on the rear wall thereof. The spiral air passage is formed by a spiral projection **24** protruding from the rear wall of the casing **11**. The spiral air passage **25** has a central flat space **25**A for receiving therein a fan **23** and functions as an air intake portion, an inner air inlet **25**B communicated with the central flat space **25**A for receiving air from the central flat space **25**A, and an outer air outlet **25**C for discharging the air from the spiral air passage **25**. A cable **14** extends from the casing **11** through the bottom wall thereof.

Referring to FIG. **5** showing a vertical-sectional view of the communication device of FIG. **4**, taken along the center line of the casing **11**, a motor **21** is mounted on the inner surface of the rear wall of the casing **11**, with a shaft **22** extending from the motor **21** and penetrating through the rear wall of the casing **11** at the center of the central flat space **25**A. The fan **23** is mounted on the other end of shaft **22** outside the casing **11**. The spiral projection **24** is formed by drawing the rear wall of the casing **11** in this embodiment. Alternatively, the spiral projection **24** may be formed by welding or bonding a spiral plate onto the rear wall. The center of the spiral air passage **25** coincides with the center of the shaft **22**.

In operation of the fan **23** by the motor **21**, air is taken in by the fan **23** from the rear side of the casing **11** to flow through the spiral air passage **25** as a spiral air flow which is substantially parallel to the rear wall of the casing **11**. The spiral air flow is discharged partly from the outer air outlet **25**C of the spiral air passage **25** and partially from the open top of the spiral air passage **25**. The heat generated in the main power circuit **26** of the communication device is irradiated through the surface of the spiral projection **24** by the air convection and the heat conduction inside the casing **11** and by the spiral air flow.

In general, in order to improve the heat radiation efficiency of a device, the surface area for the heat radiation should be increased. That is, the area in which the air inside the casing contacts with the casing should be increased. In this view point, the communication device of the present embodiment employs the drawing of the rear wall, wherein a spiral portion of the rear wall is raised by drawing to form a spiral space inside the casing **11**. This structure increases the inner surface area of the casing through which the heat is radiated.

The spiral air flow improves the heat radiation through the wall of the casing. The portion of the rear wall of the casing at which the shaft penetrates may be sealed against water. The outer end of the spiral projection **24** should have the structure shown in FIG. **4**, wherein the outer end of the spiral projection **24** overhangs the outer air outlet **25**C of the spiral air passage **25** and is directed slightly downward for protection of the communication device against rain.

The number of spiral air passages and the associated fans may be determined based on the amount of heat generated inside the casing. The casing may be made of aluminum in view of the heat radiation efficiency and the weight of the casing. The motor may be any motor driven by electrical or mechanical power.

Since the above embodiments are described only for examples, the present invention is not limited to the above embodiments and various modifications or alterations can be easily made therefrom by those skilled in the art without departing from the scope of the present invention.

What is claimed is:

1. An apparatus comprising a casing having an external surface, a spiral projection formed on said external surface to form a spiral air passage on said external surface, said spiral air passage including a central space, an inner air inlet portion communicated with said central space and an outer air outlet portion for discharging air from the spiral air passage, and a fan disposed in said central space.

2. An apparatus as defined in claim **1**, further comprising a motor disposed inside said casing for driving said fan.

3. An apparatus as defined in claim **1**, wherein said spiral projection is formed by drawing said casing.

4. An apparatus as defined in claim **1**, further comprising a communication circuit inside said casing.

* * * * *